AMENDMENTS TO THE CLAIMS

Claim 1 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency, the method comprising:

forming an aperture by selectively etching an ~~active region~~ aperture layer between a first and a second ~~reflecting~~ cladding surface, said first and the second cladding surfaces and said aperture layer are formed on an InP substrate;

said aperture reducing loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency of said VCSEL; and

wherein the etching of the ~~active region~~ aperture layer is at a rate substantially ~~faster~~ higher than a rate of etching for at least one of the first and second ~~reflecting~~ cladding surface.

Claim 2 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 1, wherein the etching is performed by a mixture comprised of a predetermined ratio of citric acid to hydrogen peroxide.

Claim 3 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 2, wherein the predetermined ratio of citric acid to hydrogen peroxide is about 3:1.

Claim 4 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency, the method comprising:

lattice matching a first reflecting surface with a first substrate layer;

lattice matching a second reflecting surface with a second substrate layer;

wherein the first substrate layer and the second substrate layers are formed on an InP material;

etching an ~~active region~~ aperture layer on the InP material between the first and the second ~~reflecting surface~~ substrate layer to form an aperture, said aperture having a predetermined size; and

said aperture reducing loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency of said VCSEL.

Claim 5 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the first reflecting surface is a first Distributed Bragg Reflector (DBR).

Claim 6 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the second reflecting surface is a second Distributed Bragg Reflector (DBR).

Claim 7 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the first substrate layer and the second substrate layer are of InP.

Claim 8 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the etching is performed by a mixture comprised of a predetermined ratio of citric acid to hydrogen peroxide.

Claim 9 (original): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 8, wherein the predetermined ratio of citric acid to hydrogen peroxide is about 3:1.

Claim 10 (currently amended): A vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency, the VCSEL comprising:

~~a first reflecting surface;~~

~~a second reflecting surface;~~

a first and a second cladding layer, said first and the second cladding layers are formed on an InP substrate;

an ~~active region~~ aperture layer substantially lattice matched to the first and the second cladding layer, the aperture layer formed on the InP substrate;

an aperture formed by selectively etching the ~~active region~~ aperture layer to a predetermined size in comparison to a size of at least one of the first and second ~~reflecting surfaces~~ cladding layers; and

said aperture reducing a loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency of said VCSEL.

Claim 11 (currently amended): The VCSEL according to claim 10, wherein the VCSEL further comprises ~~at least one cladding layer~~ a first and a second reflecting surface substantially lattice matched to the first and the second cladding layer respectively.

Claim 12 (currently amended): The VCSEL according to claim ~~10~~ 11, wherein the first reflecting surface is a first Distributed Bragg Reflector (DBR) and the second reflecting surface is a second Distributed Bragg Reflector (DBR).

Claim 13 (original): The VCSEL according to claim 12, wherein the first DBR and second DBR are made of alternating layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$ approximately lattice matched to InP.

Claim 14 (original): The VCSEL according to claim 13, wherein b is greater than about 0.5, a1 is greater than about 0.9, and a2 is less than about 0.3.

Claim 15 (currently amended): The VCSEL according to claim 12, wherein the first DBR and the second DBR are ~~preferably~~ substantially undoped.

Claim 16 (cancelled)

Claim 17 (original): The VCSEL according to claim 10, wherein the aperture is formed by etching with a predetermined ratio of citric acid to hydrogen peroxide.

Claim 18 (currently amended): The VCSEL according to claim ~~10~~ 17, wherein said ratio of citric acid to hydrogen peroxide is about 3:1.

Claim 19 (original): The VCSEL according to claim 13, wherein the first DBR and the second DBR have between eighteen and thirty-five layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$.

Claim 20 (currently amended): The VCSEL according to claim 17, wherein the ~~first reflecting surface~~ aperture layer is etched to a predetermined diameter by the citric acid and hydrogen peroxide.

Claim 21 (currently amended): The VCSEL according to claim 20, wherein the ~~active region~~ aperture layer is etched at a rate substantially faster than a rate of etch ~~applied to~~ of at least one of the first and second ~~reflecting surfaces~~ cladding layers.

Claim 22 (currently amended): A vertical-cavity surface-emitting laser (VCSEL) for decreasing threshold current, the VCSEL comprising:

a first reflecting surface;

a second reflecting surface;

an ~~active region~~ aperture layer with a first surface and a second surface, said aperture layer formed on an InP substrate;

a first cladding layer between the first reflecting surface and the first surface of the ~~active region~~ aperture layer;

a second cladding layer between the second reflecting surface and the second surface of the aperture layer ~~active region~~;

wherein said first and the second cladding layers are formed on the InP substrate;

an aperture formed by selectively etching the ~~active region~~ aperture layer to a predetermined size in comparison to a size of at least one of the first and second ~~reflecting surfaces~~ cladding layers; and

said aperture reducing a loss due to scattering in a cavity of a VCSEL, thereby decreasing threshold current in said VCSEL.

Claim 23 (currently amended): The VCSEL according to claim 22, wherein the first surface of the aperture layer ~~active region~~ has a tunnel junction.

Claim 24 (original): The VCSEL according to claim 22, wherein the first cladding layer and the second cladding layer are made of InP.

Claim 25 (original): The VCSEL according to claim 22, wherein the first reflecting surface is a first Distributed Bragg Reflector (DBR) and the second reflecting surface is a second Distributed Bragg Reflector (DBR).

Claim 26 (original): The VCSEL according to claim 25, wherein the first DBR and second DBR are made of alternating layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$ approximately lattice matched to InP.

Claim 27 (original): The VCSEL according to claim 26, wherein b is greater than about 0.5, a1 is greater than about 0.9, and a2 is less than about 0.3.

Claim 28 (currently amended): The VCSEL according to claim 25, wherein the first DBR and the second DBR are ~~doped~~ undoped ~~uniformly with n type material~~.

Claim 29 (cancelled)

Claim 30 (original): The VCSEL according to claim 22, wherein the aperture is formed by etching through a predetermined ratio of citric acid to hydrogen peroxide.

Claim 31 (currently amended): The VCSEL according to claim ~~22~~ 30, wherein said ratio of citric acid to hydrogen peroxide is about 3:1.

Claim 32 (original): The VCSEL according to claim 26, wherein the first DBR and the second DBR have between eighteen and thirty-five layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$.

Claim 33 (currently amended): The VCSEL according to claim 30, wherein the aperture layer ~~first reflecting surface~~ is etched to a predetermined diameter by the citric acid and hydrogen peroxide.

Claim 34 (currently amended): The VCSEL according to claim 33, wherein at least one of the first and the second cladding layer ~~the first reflecting surface~~ is etched at a rate slower than an etch rate of the ~~active region~~ aperture layer.

Claim 35 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency and decreasing threshold current, the method comprising:

forming an aperture of a predetermined size by selectively etching an ~~active region~~ aperture layer between a first and a second ~~reflecting~~ cladding surface, ~~said aperture having a predetermined size and formed having an opening~~ wherein the etching of the aperture layer is at a rate substantially higher than a rate of etching of the at least first and the second cladding surface;

wherein said first and the second cladding surfaces and the aperture layer are formed on an InP substrate; and

said aperture reducing loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency and decreasing threshold current of said VCSEL.

Claim 36 (currently amended): The method for aperturing a VCSEL according to claim 35, wherein the VCSEL further comprises ~~at least one cladding layer~~ a first and a second reflecting surface.

Claim 37 (currently amended): The method for aperturing a VCSEL according to claim ~~35~~ 36, wherein the first reflecting surface is a first Distributed Bragg Reflector (DBR) and the second reflecting surface is a second Distributed Bragg Reflector (DBR).

Claim 38 (original): The method for aperturing a VCSEL according to claim 37, wherein the first DBR and second DBR are made of alternating layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$ approximately lattice matched to InP.

Claim 39 (original): The method for aperturing a VCSEL according to claim 38, wherein b is greater than about 0.5, a1 is greater than about 0.9, and a2 is less than about 0.3.

Claim 40 (currently amended): The method for aperturing a VCSEL according to claim 35, wherein the first DBR and the second DBR are ~~doped~~ undoped ~~uniformly with n-type material~~.

Claim 41 (cancelled)

Claim 42 (original): The method for aperturing a VCSEL according to claim 35, wherein the aperture is formed by etching through a predetermined ratio of citric acid to hydrogen peroxide.

Claim 43 (currently amended): The method for aperturing a VCSEL according to claim ~~35~~ 42, wherein said ratio of citric acid to hydrogen peroxide is about 3:1.

Claim 44 (original): The method for aperturing a VCSEL according to claim 38, wherein the first DBR and the second DBR have between eighteen and thirty-five layers of $Al_{a1}Ga_{1-a1}As_bSb_{1-b}$ and $Al_{a2}Ga_{1-a2}As_bSb_{1-b}$.

Claim 45 (currently amended): The method for aperturing a VCSEL according to claim 42, wherein the ~~first reflecting surface~~ aperture layer is etched to a predetermined diameter by the citric acid and hydrogen peroxide.

Claim 46 (currently amended): The method for aperturing a VCSEL according to claim 45, wherein ~~the first reflecting surface~~ atleast one of the first and the second cladding surface is etched at a rate slower than an etch rate of the ~~active region~~ aperture layer.

Claim 47 (cancelled)

Claim 48 (cancelled)

Claim 49 (currently amended): The method for aperturing a VCSEL according to claim 40, wherein the ~~threshold current is decreased by~~ decrease in threshold current is more than about 20%.

Claim 50 (currently amended): The method for aperturing a VCSEL according to claim 40, wherein the ~~quantum efficiency is increased by~~ increase in quantum efficiency is more than about 10%.

Claim 51 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency and decreasing threshold current, the method comprising:

coating a wall of at least one ~~reflecting~~ cladding surface in a VCSEL with a dielectric to prevent substantial etching of the at least one cladding surface, the at least one cladding surface formed on an InP substrate;

forming an aperture by selectively etching an ~~active region~~ aperture layer of a VCSEL with an etchant, the aperture formed on the InP substrate; and

said aperture reducing loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency and decreasing threshold current of said VCSEL.

Claim 52 (original): The method for aperturing a VCSEL according to claim 51, wherein the etchant is composed of citric acid and hydrogen peroxide in a predetermined ratio.

Claim 53 (original): The method for aperturing a VCSEL according to claim 51, wherein the etchant is either H_3PO_4, or H_2O_2, or H_2O, or any combination thereof.

Claim 54 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency, the method comprising:

selectively etching an aperture between a first and a second cladding surface;

wherein said first and the second cladding surfaces are formed on an InP substrate;

said aperture designed to reduce loss due to scattering in a cavity of a VCSEL, thereby increasing external quantum efficiency of said VCSEL; and

wherein the aperture is etched at a rate substantially faster than a rate at which at least one of the first and second surfaces is etched.

Claim 55 (currently amended): A method for aperturing a vertical-cavity surface-emitting laser (VCSEL) for increasing external quantum efficiency, the method comprising:

selectively etching an aperture layer between a first and a second surface, the aperture layer being formed on an InP substrate and including at least one material with a gradually changing composition between the first and the second surface;

said first and the second surface formed on the InP substrate; wherein:

at least one of the first and second surfaces has a taper;

at least one of the first and second surfaces is formed from a first material which is etched at a rate substantially ~~faster~~ lower than the rate at which a second material forming the aperture is etched; and

wherein a selectivity of the etching between the first material and the second material is substantially ~~greater~~ lesser than unity.

Claim 56 (currently amended): The method according to claim 55, wherein the first material is a compound having ~~InGaAlAs~~ InAlAs.

Claim 57 (currently amended): The method according to claim 55, wherein the second material is a compound having ~~InAlAs~~ InGaAlAs.

Claim 58 (currently amended): The method according to claim 55, further including a first and a second cladding layer lattice matched to the first and second surfaces respectively ~~wherein the first and the second surface is made of InP~~.

Claim 59 (currently amended): The method according to claim ~~55~~ 58, wherein the first and the second cladding layer ~~material is~~ is formed of InP ~~and the second material contains As and is lattice matched to InP~~.

Claim 60 (currently amended): The method according to claim 59, wherein the ~~first and second materials are~~ aperture layer is selectively etched using an etchant containing citric acid and hydrogen peroxide.

Claim 61 (currently amended): A semiconductor laser comprised of:

photon reflecting mirrors;

cladding layers formed on an InP substrate;

an ~~active region~~ aperture layer sandwiched between the ~~mirrors~~ cladding layers, the aperture layer formed on the InP substrate; and

a first etched aperture lattice matched to the InP and having a lateral surface area less than that of at least one of the ~~mirrors~~ cladding layers.

Claim 62 (original): The laser of claim 61 wherein the material of the aperture includes As.

Claim 63 (original): The laser of claim 62 wherein the material of the aperture includes a group V element.

Claim 64 (original): The laser of claim 62 wherein the material of the aperture includes an element of the group including: Al, Ga, and In.

Claim 65 (currently amended): The laser of claim 61 further comprising a second etched aperture lattice matched to InP, having a lateral surface area less than that of at least one of the ~~mirrors~~ cladding layers, and separated from the first aperture by a layer of InP.

Claim 66 (original): The laser of claim 65 wherein the first aperture confines the current and the second aperture confines the optical mode.

Claim 67 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 2, wherein the etch has a selectivity of about 100:1.

Claim 68 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 1, wherein the aperture layer comprises of InAlGaAs.

Claim 69 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, further comprising etching at least one of the first and the second substrate layers with a reactive ion etch.

Claim 70 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the aperture layer comprises of InAlGaAs.

Claim 71 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 8, wherein the etch has a selectivity of about 100:1.

Claim 72 (new): The VCSEL according to claim 17, wherein the etch has a selectivity of about 100:1.

Claim 73 (new): The VCSEL according to claim 30, wherein the etch has a selectivity of about 100:1.

Claim 74 (new): The method for aperturing a VCSEL according to claim 43, wherein the etch has a selectivity of about 100:1.

Claim 75 (new): The method for aperturing a VCSEL according to claim 35, further comprising etching at least one of the first and the second cladding surface with a reactive ion etch.

Claim 76 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 55, wherein the at least one material includes Al.

Claim 77 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 55, wherein the at least one material includes Ga.

Claim 78 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 1, wherein the first and the second cladding surfaces are made of InP.

Claim 80 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 1, wherein the aperture layer is an active region.

Claim 82 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the aperture layer is an active region.

Claim 83 (new): The vertical-cavity surface-emitting laser (VCSEL) according to claim 10, wherein the aperture layer is an active region.

Claim 84 (new): The vertical-cavity surface-emitting laser (VCSEL) according to claim 10, wherein the aperture layer is comprised of InAlGaAs.

Claim 85 (new): The vertical-cavity surface-emitting laser (VCSEL) according to claim 10, wherein the first and the second cladding surfaces are made of InP.

Claim 86 (new): The vertical-cavity surface-emitting laser (VCSEL) according to claim 22, wherein the aperture layer is comprised of InAlGaAs.

Claim 87 (new): The vertical-cavity surface-emitting laser (VCSEL) according to claim 22, wherein the aperture layer is an active region.

Claim 88 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 35, wherein the first and the second cladding layers are made of InP.

Claim 89 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 35, wherein the aperture layer is an active region.

Claim 90 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 35, wherein the aperture layer is comprised of InAlGaAs.

Claim 91 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 51, wherein the at least one cladding surface is made of InP.

Claim 92 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 51, wherein the aperture layer is comprised of InAlGaAs.

Claim 93 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 51, wherein the aperture layer is an active region.

Claim 94 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 55, wherein the aperture layer is comprised of InAlGaAs.

Claim 95 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 55, wherein the aperture layer is an active region.

Claim 96 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 61, wherein the aperture layer is comprised of InAlGaAs.

Claim 97 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 61, wherein the aperture layer is an active region.

Claim 98 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 61, wherein the cladding surfaces are made of InP.

Claim 99 (new): The method for aperturing a VCSEL according to claim 61, wherein the aperture is formed by selectively etching the aperture layer by an etchant composed of citric acid and hydrogen peroxide in a predetermined ratio.

Claim 100 (new): The method for aperturing a vertical-cavity surface-emitting laser (VCSEL) according to claim 4, wherein the first and the second cladding surfaces are made of InP.